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(54) Heated cover device

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Dispositif de couvercle chauffé

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(56) References cited:
EP-A- 0 311 440
EP-A- 0 329 862
EP-A- 0 377 110
EP-A- 0 400 965
WO-A-86/01232
DE-A- 3 815 528

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to covers for receptacles and more particularly to a heated cover which reduces evaporative loss of a material held in a receptacle and a device for placing and removing the cover on the receptacle.

2. Description of Related Art

Some materials, in liquid or solid form, will gradually evaporate even at a relatively low temperature such as room temperature. The rate of evaporation is dependent in part on the volatility of the material, the temperature of the material and the environment to which the material is exposed. Unless evaporation is purposely intended, evaporation of material is generally undesirable since the evaporation process involves a loss of material and a change in the concentration of the material remaining in the container.

Evaporation from an open container can be reduced to some extent by covering the opening of the container. However, in situations when a small amount of material is left in a container for a prolonged period of time, for example, repeated heating during DNA sequencing reactions, the rate of evaporation is too rapid for the small amount of sample available even with the container covered. Furthermore, the evaporated material tends to condense and adhere onto the cool underside of a cover. Thus, the volume of material in the container is being reduced both by evaporation and condensation because the condensate which adheres to the cover will be removed from the container when the cover is lifted away. Moreover, for a mixture of different types of materials, the overall concentration of the mixture components remaining in the container will change as a result of evaporation. It is important in some situations to maintain a constant concentration, such as in DNA sequencing reaction processes.

EP-A-0400965 was filed on 29 May 1990 claiming priority from 30 May 1989 and published on 5 December 1990 with the designation of France, Germany and United Kingdom. Therefore, the contents of this document form part of the Statement of Article pursuant to Article 54(3) and (4) EPC with respect to France, Germany and United Kingdom. The document discloses a reagent reactor comprising a vial having an opening at one end, means for introducing and discharging fluids, a supporting block, a cover block for pressing against the supporting block to seal the vial, temperature varying means and cover temperature control means to raise the temperature of the cover to above the temperature of the support block to avoid vapour being condensed on the cover instead of being exhausted from the reactor.

EP-A-0311440 relates to an apparatus for carrying out a liquid reaction comprising a sample container which may be sandwiched between an upper and lower heater controlled to be at the same temperature to minimise a temperature gradient between the heaters. The lower heater is then removed to cool the lower surface of the container while the upper heater remains in position. There is no disclosure in this document of a control means which controls a temperature varying means (heating element) during the cooling phase. Cooling is effected by removing the lower heating element and no control is placed over this function.

SUMMARY OF THE INVENTION

The present invention is directed to a device for reducing the evaporative loss of a material which is held in a receptacle. The device comprises a laboratory device for processing a biological or chemical sample substance comprising:

a receptacle for containing a small volume of vaporizable biological or chemical substance for laboratory processing;

a cover configured to cover the receptacle;

cover temperature varying means for varying the temperature of the cover and characterised in that the device further comprises temperature varying means for varying the temperature of the receptacle; and

control means for independently controlling the cover temperature varying means and the receptacle temperature varying means to maintain the temperature of the cover to above the temperature of the receptacle, whereby a temperature gradient is maintained in a manner such that the temperature is higher away from the substance.

In another aspect of the present invention, there is provided an automated laboratory workstation comprising a laboratory device as above claims and further comprising robotic means for performing a sequence of laboratory operations with respect to the receptacle and means for moving the cover relative to the receptacle to cooperatively engage the cover and the receptacle. As an example, application of the present invention to DNA sequencing analysis will be discussed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a multi-well receptacle covered with a heated cover in accordance with one embodiment of the present invention.

Fig. 2 is a top view of a heated cover according to one embodiment of the present invention.

Fig. 3 is a section view taken along line 3-3 of the heated cover in Fig. 2.

Fig. 4 is a perspective view of an automated laboratory workstation which incorporates a cover attachment for placing and removing the heated cover with respect to a receptacle on the workstation.

Fig. 5 is a perspective view of the cover attachment in accordance with one embodiment of the present invention.

Fig. 6 is a simplified sectional view of the cover attachment of Fig. 5.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

The following description is of the best presently contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims.

The present invention will be described with reference to applications in the area of DNA research. It will be appreciated that the present invention can be applied to other areas, for scientific purposes or otherwise, in situations where evaporative loss of a material, in solid or liquid form, held in a container is to be minimized.

In DNA research, biological and chemical assays often require holding the specimen in receptacles for a prolonged period of time. Referring to Fig. 1, a multi-well receptacle 10 is shown which is used to hold DNA reagents, such as DNA polymerase and DNA templates in a solution 12 in the wells 14. As will be explained in greater detail below, the receptacle 10 may be adapted to be incorporated in an automated laboratory workstation such as the BIOMEK® 1000 developed by Beckman Instruments, Inc. which performs a sequence of functions automatically to the solution 12 without intervention by an operator.

For some analysis, it is necessary to warm the receptacle 10 to a controlled temperature to accelerate chemical reaction of the DNA material. At the elevated temperature, the solution 12 tends to evaporate at a higher rate. To reduce evaporation and consequent loss of material from the receptacle 10, it is covered with a cover 16 (indicated by dotted outlines) which is heated to above the temperature of the solution 12 contained in the receptacle 10. It has been found that the desired effect can be achieved by maintaining the temperature of the cover 16 at a temperature 5°C higher than the temperature of the solution 12. The space below the cover 16 experiences a gradual temperature gradient from the warmer cover 16 to the cooler solution 12, thereby preventing condensation from occurring on the cover.

The detail structure of the cover 16 is shown in Figs. 2 and 3. The cover 16 is sized to cover the entire top area of the receptacle 10. Referring to Fig. 3, the cover 16 has two thin plates 18 and 20 made of rigid, heat tolerant material. It has been found that ceramics, glass, or silicon rubber, for example, are acceptable materials for the plate 20.

Sandwiched between the plates 18 and 20 is an electrical resistive heating element 22 which may be in the form of a small diameter Nichrome wire or formed by depositing resistive materials such as Nichrome or stannous oxide on one of the plates. As an example, a 36 gauge Nichrome wire with a resistivity of 12 Ohms per 0.3048m (12 Ohms per foot) may be used to provide sufficient heating to the cover 16. The heating element 22 is configured in a serpentine fashion across the area of the plates 18 and 20 so as to provide uniform heating across the cover 16. A filler material such as epoxy may be used to secure the plates and to fill the voids between the plates 18 and 20. The epoxy retains and distributes the heat within the cover 16.

The heating element 22 is connected to a variable power supply 24 which can be controlled to provide current for heating the cover 16 to a desired temperature. The leads 26 and 28 between the power supply 24 and the heating element 22 may be flexible and configured to avoid stress in the leads 26 and 28 so that the cover 16 can be moved without restriction, e.g. by a robotic means in an automated laboratory workstation. A temperature sensor 30 may be provided on the cover 16 to measure its temperature and provide feedback for controlling the power supply 24 for obtaining a desired temperature.

It is emphasized that the "heating" of the cover 16 described above is in reference to the temperature of the volatile substance. In the examples described throughout the disclosure herein, the temperature of the substance in the receptacle is at or above ambient temperature. It is contemplated that for situations in which the temperature of the substance is below ambient temperature, it may be desirable to cool the cover to a temperature below ambient but above the temperature of the substance vapor. This is to maintain minimum temperature differential between the cover and the substance so that the temperature of the cover would not affect the controlled temperature of the substance in the receptacle.

Frequently, in laboratory experiments involving biochemical compounds such as DNA, it is necessary to maintain a temperature for a period of time that will retard or accelerate or in some way enhance a reaction. Temperature is used to control rates of biochemical reactions, in this particular case the enzymatic extension of long chain molecules such as DNA. Sometimes higher temperatures are used to dissociate the double stranded chain of the DNA molecules. Cooling is used to reassociate the separated chains with complimentary primer DNA molecules. In these examples, timing of the application of the heating or cooling of the chemical compositions can play a paramount role in the results and extensive evaporative loss of the chemical compositions can affect the results of the experiments. The present invention provides an attachment for use on an automated laboratory workstation to control the temperature of the chemical compositions while reducing evaporative loss.

A mechanical means of automatically placing and removing the heated cover on and from the receptacle 10 has been developed in connection with the Beckman BIOMEK® 1000 automated laboratory workstation.

Referring to Fig. 4, a perspective view of an automated laboratory workstation 30 similar to the BIOMEK® 1000 is shown. This workstation has been described in detail in copending U.S. patent application Serial No. 07/383,299 also assigned to the assignee of the present invention. For purposes of discussion of the present invention herein, only the relevant components of the automated laboratory workstation 30 shown in Fig. 4 will be described.

The workstation 30 comprises a base 32 on which a tablet 34 is moved horizontally (arrow X) by stepping motors (not shown). The tablet 34 supports a number of tool stands 36 for holding various tools, for example multiple-port pipette 38; a tray 40 for holding for example pipette tips 42; multi-well titer plates 44; a reservoir 46 for holding solutions; and other labwares required for carrying out a sequence of laboratory operations. A tower 48 vertically extends from the base 32. A horizontally supported arm 50 can be moved vertically (arrow Z) along the tower 48. A robot hand 52 is supported at the end of the arm 50. The robot hand 52 is designed to pick up and manipulate the tools 38. The robot hand 52 is movable horizontally along the arm 50 in a transverse direction (arrow Y) with respect to the tablet 34 horizontal movement (arrow X). It can be seen that through the combined vertical (Z), horizontal (X) and transverse (Y) motions of the arm 50, tablet 34 and robot hand 52, respectively, a series of laboratory steps can be sequentially performed, for example pipetting a desired quantity of reagent from reservoir 46 into the multi-well titer plate 44. The movements of the various robotic components are actuated by stepper motors and lead screws controlled by a mini-computer 54.

The heated cover described above may be incorporated into the workstation 30 by an attachment 60 which is more clearly shown in Figs. 5 and 6. This attachment 60 will be referred to as a contact incubator. The term "contact" is derived from the fact that the plate 62 of the device 60 actually come into intimate contact with the multi-well titer plate 44 that is to be incubated. The incubator 60 comprises a temperature controlled plate 62 which may be heated or cooled and a heated cover 64. As will be appreciated following the description of the incubator 60 below, by incorporating the temperature-controlled plate 62 and cover 64 into the automated workstation 30, the heating and cooling requirements of a laboratory procedure such as incubation of DNA specimens can be programmed into the control 54 for the automated workstation 30 to allow the procedure to be carried out without further operator intervention.

The cover 64 may have a structure similar to that described with respect to Figs. 2 and 3. Cover 64 may be formed from resilient material to provide a seal with the upper surface of the titer plate 44 thereby sealing individual wells 14. The cover 64 is supported by an upper jaw 66 which is pivoted to the frame 68 at pivot 67. The temperature-controlled plate 62 is supported on a lower jaw 70 which is pivoted to the frame 68 at pivot 69. A lead screw 72 driven by a motor 74 couples the ends 76 and 78 of the jaws 66 and 70 on the other side of the pivots 67 and 69. The ends 76 and 78 of the jaws may be drawn towards one another or moved apart by rotation of the lead screw 72. Such motion causes the jaws 66 and 70 to open or close, respectively.

The incubator 60 is attached to the base 32 of the workstation 30. Thus, by moving the tablet 34 to position the multi-well titer plate 44 in between the jaws 66 and 70, the cover 64 and temperature controlled plate 62 can be "clamped" on the multi-well titer plate 44. At the clamped configuration, the temperature controlled plate 62 is pressed against the bottom of the multi-well titer plate 44 and the cover 64 is pressed over the titer plate 44. The plate 62 therefore controls the temperature of the contents of the multi-well plate 44 and the cover 64 reduces evaporation of the contents. It has been found that a cover temperature of 5°C above the temperature of the plate 62 is sufficient to reduce evaporation.

The temperature controlled plate 62 may be made of resilient material and heated or cooled by embedded Peltier elements, resistance wires, or temperature controlled fluid circulated within the plate. The temperature control plate 62 can be preheated prior to clamping on the multi-well titer plate 44. This will enable a rapid temperature rise to be imparted to the multi-well plate 44 once the plate 62 comes into contact with the multi-well titer plate 44. Thereafter, the plate 62 is allowed to cool slowly by controlling the heating current. Other desired heating and cooling profiles may be programmed by suitable microprocessor control of the power supplied to the temperature control plate 62 and to the cover 64. It has also been found that more rapid heating or cooling can be accomplished by incorporating graphite particles or metal particles in the resilient material of the temperature controlled plate 62.

The top surface of the temperature controlled plate 62 may be provided with wells which conform to the shape of the underside of the multi-well titer plate 44. This enables the plate 62 to come into close contact with the multi-well titer plate 44 for efficient temperature transfer.

It is to be understood that in situations where the temperature of the multi-well titer plate 44 is not to be controlled, only the temperature of the cover 64 is controlled to reduce evaporative loss and the plate 62 is either not clamped against the underside of the multi-well plate 44 or is not activated.

It can be seen that by integrating a temperature-controlled plate 62 and cover 64 in the automated workstation 30, the temperature of the contents of the multi-well titer plate can be accurately controlled and the evaporative loss of the contents can be reduced. A sequence of laboratory functions can be performed automatically without operator intervention. For example, the sequence may include dispensing an initial amount of biochemical specimen into the micro-well titer plate 44, moving the tablet 34 to position the micro-well titer plate 44 in between the jaws 66 and 70 of the incubator 30, clamping the multi-well titer plate 44 to begin a temper-

ature-controlled incubation cycle, withdrawing the multi-well titer plate 44 from the incubator 60 for addition of specimens or reagents, further incubation, and other desired laboratory procedures to be performed to the contents of the multi-well titer plate 44.

It will be appreciated that the size and shape of the heated cover may be selected depending on the size and shape of the receptacle. Instead of sandwiching the heating element between two plates, the heating element may be disposed on one side of a plate or embedded within a slab. Other means of heating the cover plate may be utilized. The clamping mechanism may be incorporated in other types of workstations or used as a stand-alone contact incubator. The clamping mechanism may be caused to move by the workstation to approach a stationary receptacle. The jaws of the clamping mechanism may be independently actuated using separate controls. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrated embodiments, but only by the scope of the appended claims.

Claims

Claims for the following Contracting States : CH, IT, LI

1. A laboratory device (60) for processing a biological or chemical sample substance comprising:

   a receptacle (10, 44) for containing a small volume of vaporizable biological or chemical substance (12) for laboratory processing;

   a cover (16, 64) configured to cover the receptacle;

   cover temperature varying means (22) for varying the temperature of the cover and characterised in that the device further comprises temperature varying means (62) for varying the temperature of the receptacle; and

   control means (24, 54) for independently controlling the cover temperature varying means (22) and the receptacle temperature varying means (62) to maintain the temperature of the cover above the temperature of the receptacle, whereby a temperature gradient is maintained in a manner such that the temperature is higher away from the substance.

2. A device as in claim 1 wherein the control means includes feedback means (30) for feeding back the actual temperature of the cover.

3. A device as in any of the above claims wherein the control means further actively controls the temperature varying means to maintain the temperature of the cover and the receptacle in accordance with a specified temperature profile.

4. A device as in any of the above claims further comprising positioning means (66, 67, 68) for positioning the cover onto the receptacle.

5. A device as in claim 4 wherein the positioning means includes means (72, 74, 76, 78) for providing automatic control to control the positioning of the cover onto the receptacle.

6. A device as in any of claims 4 or 5 wherein the positioning means further includes means (67, 68) for pivoting the cover onto the receptacle.

7. A device as in claim 6 further comprising means (34) for positioning the receptacle relative to the receptacle temperature varying means for cooperative engagement therewith.

8. A device as in any of claims 6 or 7 wherein the receptacle temperature varying means controls the temperature of the substance in accordance with a specified temperature profile.

9. A device as in any of the above claims wherein the control means controls the corresponding temperature varying means to maintain the temperature of the cover to be slightly above the temperature of the substance in the receptacle.

10. A device as in any of the above claims wherein the control means controls the corresponding temperature varying means to maintain the temperature of the cover to be at a substantially fixed given temperature above the temperature of the substance in the receptacle.

11. A device as in any of the above claims wherein the control means controls the corresponding temperature varying means to maintain the temperature of the cover to be substantially 5°C above the temperature of the substance in the receptacle.

12. A device as in any of the above claims wherein the receptacle comprises multiple sample wells (14).

13. A device as in any of the above claims further comprising robotic means (50, 52) for performing a sequence of laboratory operations with respect to the receptacle.

14. An automated laboratory workstation (30) comprising a laboratory device according to any one of the preceding claims and further comprising robotic means (50, 52) for performing a sequence of laboratory operations with respect to the receptacle and means (66, 67, 68) for moving the cover relative to the receptacle to cooperatively engage the cover and the receptacle.

15. An automated laboratory workstation as in claim 14 wherein the cover is pivotally supported with respect to the receptacle.

16. An automated laboratory workstation as in claim 14 or 15 wherein the means for effecting temperature control of the substance comprises a temperature controlled base (62) configured to be positioned against the receptacle to effect temperature control.

17. An automated laboratory workstation as in any one of claims 14 to 16 wherein the cover and the base are disposed in opposing relation wherein the moving means comprises means (34) for positioning the receptacle between the cover and the base so that the cover can be moved relative to the base to sandwich the receptacle therebetween to effect temperature control of the receptacle while covering the receptacle.

18. An automated laboratory workstation as in any one of claims 14 to 17 wherein the robotic means comprises a means (38) for transferring the substance.

19. An automated laboratory workstation as in claim 18 wherein the means for transferring the substance comprises a pipet (38).

Claims for the following Contracting States : DE, FR, GB

1. A laboratory device (60) for processing a biological or chemical sample substance comprising:

a receptacle in the form of a plate (10, 44) for containing a small volume of vaporizable biological or chemical substance (12) for laboratory processing;

a cover (16, 64) configured to cover the receptacle;

cover temperature varying means (22) for varying the temperature of the cover and characterised in that the device further comprises temperature varying means (62) for varying the temperature of the receptacle; and

control means (24, 54) for independently controlling the cover temperature varying means (22) and the receptacle temperature varying means (62) to maintain the temperature of the cover above the temperature of the receptacle, whereby a temperature gradient is maintained in a manner such that the temperature is higher away from the substance.

2. A device as in claim 1 wherein the control means includes feedback means (30) for feeding back the actual temperature of the cover.

3. A device as in any of the above claims wherein the control means further actively controls the temperature varying means to maintain the temperature of the cover and the receptacle in accordance with a specified temperature profile.

4. A device as in any of the above claims further comprising positioning means (66, 67, 68) for positioning the cover onto the receptacle.

5. A device as in claim 4 wherein the positioning means includes means (72, 74, 76, 78) for providing automatic control to control the positioning of the cover onto the receptacle.

6. A device as in any of claims 4 or 5 wherein the positioning means further includes means (67, 68) for pivoting the cover onto the receptacle.

7. A device as in claim 6 further comprising means (34) for positioning the receptacle relative to the receptacle temperature varying means for cooperative engagement therewith.

8. A device as in any of claims 6 or 7 wherein the receptacle temperature varying means controls the temperature of the substance in accordance with a specified temperature profile.

9. A device as in any of the above claims wherein the control means controls the corresponding temperature varying means to maintain the temperature of the cover to be slightly above the temperature of the substance in the receptacle.

10. A device as in any of the above claims wherein the control means controls the corresponding temperature varying means to maintain the temperature of the cover to be at a substantially fixed given temperature above the temperature of the substance in the receptacle.

11. A device as in any of the above claims wherein the control means controls the corresponding temperature varying means to maintain the temperature of the cover to be substantially 5°C above the temperature of the substance in the receptacle.

12. A device as in any of the above claims wherein the receptacle comprises multiple sample wells (14).

13. A device as in any of the above claims further comprising robotic means (50, 52) for performing a sequence of laboratory operations with respect to the receptacle.

14. An automated laboratory workstation (30) comprising a laboratory device according to any one of the preceding claims and further comprising robotic means (50, 52) for performing a sequence of laboratory operations with respect to the receptacle and means (66, 67, 68) for moving the cover relative to the receptacle to cooperatively engage the cover and the receptacle.

15. An automated laboratory workstation as in claim 14 wherein the cover is pivotally supported with respect to the receptacle.

16. An automated laboratory workstation as in claim 14 or 15 wherein the means for effecting temperature control of the substance comprises a temperature controlled base (62) configured to be positioned against the receptacle to effect temperature control.

17. An automated laboratory workstation as in any one of claims 14 to 16 wherein the cover and the base are disposed in opposing relation wherein the moving means comprises means (34) for positioning the receptacle between the cover and the base so that the cover can be moved relative to the base to sandwich the receptacle therebetween to effect temperature control of the receptacle while covering the receptacle.

18. An automated laboratory workstation as in any one of claims 14 to 17 wherein the robotic means comprises a means (38) for transferring the substance.

19. An automated laboratory workstation as in claim 18 wherein the means for transferring the substance comprises a pipet (38).

Patentansprüche

Patentansprüche für folgende Vertragsstaaten : CH, IT, LI

1. Laboratoriumsvorrichtung (60) zur Behandlung einer biologischen oder chemischer Probensubstanz, umfassend:

einen Behälter (10,44) zur Aufnahme eines kleinen Volumens von verdampfbarer biologischer oder chemischer Substanz (12) zur Laboratoriumsbehandlung;

einen Deckel (16,64) mit einer Formgebung zur Abdeckung des Behälters;

Mittel (22) zur Veränderung der Temperatur des Deckels und dadurch gekennzeichnet, daß die Vorrichtung des weiteren Temperaturveränderungs mittel (62) zur Veränderung der Temperatur des Behälters aufweist; und

Regel- bzw. Steuermittel (24,54) zur unabhängigen Regelung bzw. Steuerung der Deckeltemperatur-Veränderungsmittel (22) und der Behältertemperatur-Veränderungsmittel (62), um die Temperatur des Deckels oberhalb der Temperatur des Behälters zu halten, derart daß ein Temperaturgradient in einer solchen Weise aufrechterhalten wird, daß die Temperatur in der Entfernung von der Substanz weg höher ist.

2. Vorrichtung nach Anspruch 1, bei welcher die Regel- bzw. Steuermittel Rückkopplungsmittel (30) zur Rückkopplung der tatsächlichen oder Ist-Temperatur des Deckels aufweisen.

3. Vorrichtung nach einem der vorstehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel des weiteren aktiv die Temperaturveränderungsmittel steuern, um die Temperatur des Deckels und des Behälters nach Maßgabe eines bestimmten Temperaturprofils zu halten.

4. Vorrichtung nach einem der vorherstehenden Ansprüche, des weiteren umfassend Positioniermittel (66,67,68) zur Positionierung des Deckels auf dem Behälter.

5. Vorrichtung nach Anspruch 4, bei welcher die Positionierungsmittel Mittel (72,74,76,78) zur Schaffung einer automatischen Steuerung für die Positionierung des Deckels auf dem Behälter aufweisen.

6. Vorrichtung nach einem der Ansprüche 4 oder 5, bei welcher die Positionierungsmittel des weiteren Mittel (67,68) zum Verschwenken oder Umklappen des Deckels auf den Behälter aufweisen.

7. Vorrichtung nach Anspruch 6, des weiteren umfassend Mittel (34) zur Positionierung des Behälters relativ bezüglich der Behältertemperatur-Änderungsmittel zum Zusammenwirkungseingriff mit diesen.

8. Vorrichtung nach einem der Ansprüche 6 oder 7, bei welcher die Behältertemperatur-Veränderungsmittel die Temperatur der Substanz nach Maßgabe eines vorgegebenen Temperaturprofils regeln bzw. steuern.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel die entsprechenden Temperaturveränderungsmittel so regeln bzw. steuern, daß die Temperatur des Deckels geringfügig über der Temperatur der Substanz in dem Behälter gehalten wird.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel die entsprechenden Temperaturveränderungsmittel so regeln bzw. steuern, daß die Temperatur des Deckels auf einer im wesentlichen festen vorgegebenen Temperatur oberhalb der Temperatur der Substanz in dem Behälter gehalten wird.

11. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel die entsprechenden Temperaturveränderungsmittel so regeln bzw. steuern, daß die Temperatur des Deckels im wesentlichen 5°C oberhalb der Temperatur der Substanz in dem Behälter gehalten wird.

12. Vorrichtung nach einer der vorhergehenden Ansprüche, bei welcher der Behälter eine Vielzahl von Probenausnehmungen bzw. -bohrungen (14) aufweist.

13. Vorrichtung nach einem der vorhergehenden Ansprüche, des weiteren umfassend Robotermittel (50,52) zur Durchführung einer Sequenz von Laboratoriumsoperationen bezüglich dem Behälter.

14. Automatisierte Laboratoriums-Arbeitsstation (30) umfassend eine Laboratoriumsvorrichtung gemäß einem der vorhergehenden Ansprüche, und des weiteren umfassend Robotermittel (50,52) zur Durchführung einer Sequenz von Laboratoriums-Operationen bezüglich dem Behälter und Mittel (66,67,68) zur Verstellung des Deckels relativ bezüglich dem Behälter zum Wirkungseingriff zwischen dem Deckel und dem Behälter.

15. Automatisierte Laboratoriums-Arbeitsstation nach Anspruch 14, bei welcher der Deckel schwenkbar bezüglich dem Behälter angebracht ist.

16. Automatisierte Laboratoriums-Arbeitsstation nach Anspruch 14 oder 15, bei welcher die Mittel zur wirksamen Regelung bzw. Steuerung der Temperatur der Substanz eine temperaturgesteuerte Grundplatte (62) solcher Formgebung aufweisen, daß sie zur Anlage gegen den Behälter gebracht werden kann, um eine Temperaturregelung bzw. -steuerung zu bewirken.

17. Automatisierte Laboratoriums-Arbeitsstation nach einem der Ansprüche 14 bis 16, bei welcher der Deckel und die Grundplatte einander gegenüberliegend angeordnet sind, und bei welcher die Verstellmittel Mittel (34) zur Positionierung des Behälters zwischen dem Deckel und der Grundplatte aufweisen, derart daß der Deckel relativ bezüglich der Grundplatte verstellbar ist, um den Behälter sandwich-artig zwischen Deckel und Grundplatte anzuordnen, derart daß beim Abdecken des Behälters gleichzeitig eine Temperaturregelung bzw. -steuerung des Behälters bewirkt wird.

18. Automatisierte Laboratoriums-Arbeitsstation nach einem der Ansprüche 14 bis 17, bei welcher die Robotermittel eine Vorrichtung (38) zur Überführung der Substanz aufweisen.

19. Automatisierte Laboratoriums-Arbeitsstation nach Anspruch 18, bei welcher die Mittel zur Überführung der Substanz eine Pipette (38) aufweisen.

Patentansprüche für folgende Vertragsstaaten : DE, FR, GB

1. Laboratoriumsvorrichtung (60) zur Behandlung einer biologischen oder chemischen Probensubstanz, umfassend:

einen Behälter in Form einer Platte (10,44) zur Aufnahme eines kleinen Volumens von verdampfbarer biologischer oder chemischer Substanz (12) zur Laboratoriumsbehandlung;

einen Deckel (16,64) mit einer Formgebung zur Abdeckung des Behälters;

Mittel (22) zur Veränderung der Temperatur des Deckels und dadurch gekennzeichnet, daß die Vorrichtung des weiteren Temperaturveränderungsmittel (62) zur Veränderung der Temperatur des Behälters aufweist; und

Regel- bzw. Steuermittel (24,54) zur unabhängigen Regelung bzw. Steuerung der Deckeltemperatur-Veränderungsmittel (22) und der Behältertemperatur-Veränderungsmittel (62), um die Temperatur des Deckels oberhalb der Temperatur des Behälters zu halten, derart daß ein Temperaturgradient in einer solchen Weise aufrechterhalten wird, daß die Temperatur in der Entfernung von der Substanz weg höher ist.

2. Vorrichtung nach Anspruch 1, bei welcher die Regel- bzw. Steuermittel Rückkopplungsmittel (30) zur Rückkopplung der tatsächlichen oder Ist-Temperatur des Deckels aufweisen.

3. Vorrichtung nach einem der vorstehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel des weiteren aktiv die Temperaturveränderungsmittel steuern, um die Temperatur des Deckels und des Behälters nach Maßgabe eines bestimmten Temperaturprofils zu halten.

4. Vorrichtung nach einem der vorherstehenden Ansprüche, des weiteren umfassend Positioniermittel (66,67,68) zur Positionierung des Deckels auf dem Behälter.

5. Vorrichtung nach Anspruch 4, bei welcher die Positionierungsmittel Mittel (72,74,76,78) zur Schaffung einer automatischen Steuerung für die Positionierung des Deckels auf dem Behälter aufweisen.

6. Vorrichtung nach einem der Ansprüche 4 oder 5, bei welcher die Positionierungsmittel des weiteren Mittel (67,68) zum Verschwenken oder Umklappen des Deckels auf den Behälter aufweisen.

7. Vorrichtung nach Anspruch 6, des weiteren umfassend Mittel (34) zur Positionierung des Behälters relativ bezüglich der Behältertemperatur-Änderungsmittel zum Zusammenwirkungseingriff mit diesen.

8. Vorrichtung nach einem der Ansprüche 6 oder 7, bei welcher die Behältertemperatur-Veränderungsmittel die Temperatur der Substanz nach Maßgabe

eines vorgegebenen Temperaturprofils regeln bzw. steuern.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel die entsprechenden Temperaturveränderungsmittel so regeln bzw. steuern, daß die Temperatur des Deckels geringfügig über der Temperatur der Substanz in dem Behälter gehalten wird.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel die entsprechenden Temperaturveränderungsmittel so regeln bzw. steuern, daß die Temperatur des Deckels auf einer im wesentlichen festen vorgegebenen Temperatur oberhalb der Temperatur der Substanz in dem Behälter gehalten wird.

11. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Regel- bzw. Steuermittel die entsprechenden Temperaturveränderungsmittel so regeln bzw. steuern, daß die Temperatur des Deckels im wesentlichen 5°C oberhalb der Temperatur der Substanz in dem Behälter gehalten wird.

12. Vorrichtung nach einem der vornergehenden Ansprüche, bei welcher der Behälter eine Vielzahl von Probenausnehmungen bzw. -bohrungen (14) aufweist.

13. Vorrichtung nach einem der vorhergehenden Ansprüche, des weiteren umfassend Robotermittel (50,52) zur Durchführung einer Sequenz von Laboratoriumsoperationen bezüglich dem Behälter.

14. Automatisierte Laboratoriums-Arbeitsstation (30) umfassend eine Laboratoriumsvorrichtung gemäß einem der vorhergehenden Ansprüche, und des weiteren umfassend Robotermittel (50,52) zur Durchführung einer Sequenz von Laboratoriums-Operationen bezüglich dem Behälter und Mittel (66,67,68) zur Verstellung des Deckels relativ bezüglich dem Behälter zum Wirkungseingriff zwischen dem Deckel und dem Behälter.

15. Automatisierte Laboratoriums-Arbeitsstation nach Anspruch 14, bei welcher der Deckel schwenkbar bezüglich dem Behälter angebracht ist.

16. Automatisierte Laboratoriums-Arbeitsstation nach Anspruch 14 oder 15, bei welcher die Mittel zur wirksamen Regelung bzw. Steuerung der Temperatur der Substanz eine temperaturgesteuerte Grundplatte (62) solcher Formgebung aufweist, daß sie zur Anlage gegen den Behälter gebracht werden kann, um eine Temperaturregelung bzw. -steuerung zu bewirken.

17. Automatisierte Laboratoriums-Arbeitsstation nach einem der Ansprüche 14 bis 16, bei welcher der Deckel und die Grundplatte einander gegenüberliegend angeordnet sind, und bei welcher die Verstellmittel Mittel (34) zur Positionierung des Behälters zwischen dem Deckel und der Grundplatte aufweisen, derart daß der Deckel relativ bezüglich der Grundplatte verstellbar ist, um den Behälter sandwich-artig zwischen Deckel und Grundplatte anzuordnen, derart daß beim Abdecken des Behälters gleichzeitig eine Temperaturregelung bzw. -steuerung des Behälters bewirkt wird.

18. Automatisierte Laboratoriums-Arbeitsstation nach einem der Ansprüche 14 bis 17, bei welcher die Robotermittel eine Vorrichtung (38) zur Überführung der Substanz aufweisen.

19. Automatisierte Laboratoriums-Arbeitsstation nach Anspruch 18, bei welcher die Mittel zur Überführung der Substanz eine Pipette (38) aufweisen.

Revendications

Revendications pour les Etats contractants suivants : CH, IT, LI

1. Dispositif de laboratoire (60) pour le traitement d'une substance échantillon biologique ou chimique comprenant :
un réceptacle sous la forme d'une plaque (10, 44) pour contenir un petit volume de substance biologique ou chimique vaporisable (12) pour un traitement en laboratoire;
un couvercle (16, 64) configuré pour couvrir le réceptacle;
un moyen variant la température du couvercle (22) pour varier la température du couvercle et caractérisé en ce que le dispositif comporte de plus un moyen (62) variant la température pour varier la température du réceptacle; et
un moyen de commande (24, 54) pour commander indépendamment le moyen variant la température du couvercle (22) et le moyen variant la température du réceptacle (62) pour maintenir la température du couvercle au-dessus de la température du réceptacle, pour maintenir un gradient de température d'une manière telle que la température soit plus élevée au loin de la substance.

2. Dispositif selon la revendication 1 où le moyen de commande comporte un moyen de réaction (30) pour réappliquer la température réelle du couvercle.

3. Dispositif selon l'une quelconque des revendications précédentes où le moyen de commande commande de plus activement le moyen variant la température pour maintenir la température du cou-

vercle et du réceptacle selon un profil spécifié de température.

4. Dispositif selon l'une quelconque des revendications ci-dessus comprenant de plus un moyen de positionnement (66, 67, 68) pour positionner le couvercle sur le réceptacle.

5. Dispositif selon la revendication 4 où le moyen de positionnement comporte un moyen (72, 74, 76, 78) pour produire un contrôle automatique pour contrôler la position du couvercle sur le réceptacle.

6. Dispositif selon l'une quelconque des revendications 4 ou 5 où le moyen de positionnement comporte de plus un moyen (67, 68) pour faire pivoter le couvercle sur le réceptacle.

7. Dispositif selon la revendication 6 comprenant de plus un moyen (34) pour positionner le réceptacle relativement au moyen variant la température du réceptacle pour un engagement de coopération entre eux.

8. Dispositif selon l'une quelconque des revendications 6 ou 7 où le moyen variant la température du réceptacle contrôle la température de la substance selon un profil spécifié de température.

9. Dispositif selon l'une quelconque des revendications ci-dessus où le moyen de commande commande le moyen variant la température correspondante pour maintenir la température du couvercle pour qu'elle soit légèrement au-dessus de la température de la substance dans le réceptacle.

10. Dispositif selon l'une quelconque des revendications précédentes où le moyen de commande commande le moyen variant la température correspondante pour maintenir la température du couvercle pour qu'elle soit à une température donnée sensiblement fixe au-dessus de la température de la substance dans le réceptacle.

11. Dispositif selon l'une quelconque des revendications ci-dessus où le moyen de commande commande le moyen variant la température correspondante pour maintenir la température du couvercle pour qu'elle soit sensiblement à 5°C au-dessus de la température de la substance dans le réceptacle.

12. Dispositif selon l'une quelconque des revendications précédentes où le réceptacle comprend des puits multiples d'échantillon (14).

13. Dispositif selon l'une quelconque des revendications ci-dessus comprenant de plus un moyen robotique (50, 52) pour accomplir une séquence d'opérations de laboratoire par rapport au réceptacle.

14. Station automatisée de laboratoire (30) comprenant un dispositif de laboratoire selon l'une quelconque des revendications précédentes et comprenant de plus un moyen robotique (50, 52) pour accomplir une séquence d'opérations de laboratoire par rapport au réceptacle et un moyen (66, 67, 68) pour déplacer le couvercle relativement au réceptacle pour un engagement coopératif entre le couvercle et le réceptacle.

15. Station automatisée de laboratoire selon la revendication 14 où le couvercle est supporté pivotant par rapport au réceptacle.

16. Station automatisée de laboratoire selon la revendication 14 ou 15 où le moyen pour effectuer le contrôle de la température de la substance comprend une base à température contrôlée (62) configurée pour être placée contre le réceptacle pour effectuer un contrôle de la température.

17. Station automatisée de laboratoire selon l'une quelconque des revendications 14 à 16 où le couvercle et la base sont disposés en relation face à face où le moyen de déplacement comprend un moyen (34) pour positionner le réceptacle entre le couvercle et la base de manière que le couvercle puisse être déplacé relativement à la base pour mettre le réceptacle en sandwich entre eux afin d'effectuer le contrôle de la température du réceptacle tout en couvrant le réceptacle.

18. Station automatisée de laboratoire selon l'une quelconque des revendications 14 à 17 où le moyen robotique comprend un moyen (38) pour transférer la substance.

19. Station automatisée de laboratoire selon la revendication 18 où le moyen pour transférer la substance comprend une pipette (38).

Revendications pour les Etats contractants suivants : DE, FR, GB

1. Dispositif de laboratoire (60) pour le traitement d'une substance échantillon biologique ou chimique comprenant :
un réceptacle sous la forme d'une plaque (10, 44) pour contenir un petit volume de substance biologique ou chimique vaporisable (12) pour un traitement en laboratoire;
un couvercle (16, 64) configuré pour couvrir le réceptacle;
un moyen variant la température du couvercle (22) pour varier la température du couvercle et caractérisé en ce que le dispositif comporte de plus un

moyen (62) variant la température pour varier la température du réceptacle; et
un moyen de commande (24, 54) pour commander indépendamment le moyen variant la température du couvercle (22) et le moyen variant la température du réceptacle (62) pour maintenir la température du couvercle au-dessus de la température du réceptacle, pour maintenir un gradient de température d'une manière telle que la température soit plus élevée au loin de la substance.

2. Dispositif selon la revendication 1 où le moyen de commande comporte un moyen de réaction (30) pour réappliquer la température réelle du couvercle.

3. Dispositif selon l'une quelconque des revendications précédentes où le moyen de commande commande de plus activement le moyen variant la température pour maintenir la température du couvercle et du réceptacle selon un profil spécifié de température.

4. Dispositif selon l'une quelconque des revendications ci-dessus comprenant de plus un moyen de positionnement (66, 67, 68) pour positionner le couvercle sur le réceptacle.

5. Dispositif selon la revendication 4 où le moyen de positionnement comporte un moyen (72, 74, 76, 78) pour produire un contrôle automatique pour contrôler la position du couvercle sur le réceptacle.

6. Dispositif selon l'une quelconque des revendications 4 ou 5 où le moyen de positionnement comporte de plus un moyen (67, 68) pour faire pivoter le couvercle sur le réceptacle.

7. Dispositif selon la revendication 6 comprenant de plus un moyen (34) pour positionner le réceptacle relativement au moyen variant la température du réceptacle pour un engagement de coopération entre eux.

8. Dispositif selon l'une quelconque des revendications 6 ou 7 où le moyen variant la température du réceptacle contrôle la température de la substance selon un profil spécifié de température.

9. Dispositif selon l'une quelconque des revendications ci-dessus où le moyen de commande commande le moyen variant la température correspondante pour maintenir la température du couvercle pour qu'elle soit légèrement au-dessus de la température de la substance dans le réceptacle.

10. Dispositif selon l'une quelconque des revendications précédentes où le moyen de commande commande le moyen variant la température correspondante pour maintenir la température du couvercle pour qu'elle soit à une température donnée sensiblement fixe au-dessus de la température de la substance dans le réceptacle.

11. Dispositif selon l'une quelconque des revendications ci-dessus où le moyen de commande commande le moyen variant la température correspondante pour maintenir la température du couvercle pour qu'elle soit sensiblement à 5°C au-dessus de la température de la substance dans le réceptacle.

12. Dispositif selon l'une quelconque des revendications précédentes où le réceptacle comprend des puits multiples d'échantillon (14).

13. Dispositif selon l'une quelconque des revendications ci-dessus comprenant de plus un moyen robotique (50, 52) pour accomplir une séquence d'opérations de laboratoire par rapport au réceptacle.

14. Station automatisée de laboratoire (30) comprenant un dispositif de laboratoire selon l'une quelconque des revendications précédentes et comprenant de plus un moyen robotique (50, 52) pour accomplir une séquence d'opérations de laboratoire par rapport au réceptacle et un moyen (66, 67, 68) pour déplacer le couvercle relativement au réceptacle pour un engagement coopératif entre le couvercle et le réceptacle.

15. Station automatisée de laboratoire selon la revendication 14 où le couvercle est supporté pivotant par rapport au réceptacle.

16. Station automatisée de laboratoire selon la revendication 14 ou 15 où le moyen pour effectuer le contrôle de la température de la substance comprend une base à température contrôlée (62) configurée pour être placée contre le réceptacle pour effectuer un contrôle de la température.

17. Station automatisée de laboratoire selon l'une quelconque des revendications 14 à 16 où le couvercle et la base sont disposés en relation face à face où le moyen de déplacement comprend un moyen (34) pour positionner le réceptacle entre le couvercle et la base de manière que le couvercle puisse être déplacé relativement à la base pour mettre le réceptacle en sandwich entre eux afin d'effectuer le contrôle de la température du réceptacle tout en couvrant le réceptacle.

18. Station automatisée de laboratoire selon l'une quelconque des revendications 14 à 17 où le moyen robotique comprend un moyen (38) pour transférer la substance.

19. Station automatisée de laboratoire selon la revendication 18 où le moyen pour transférer la substance comprend une pipette (38).

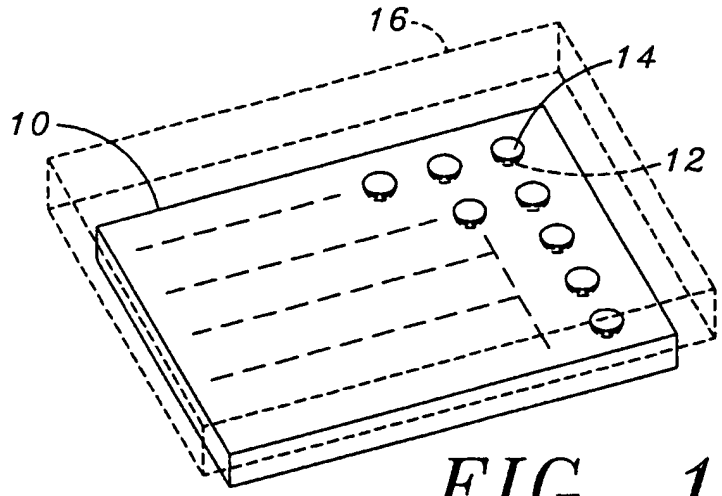


FIG. 1

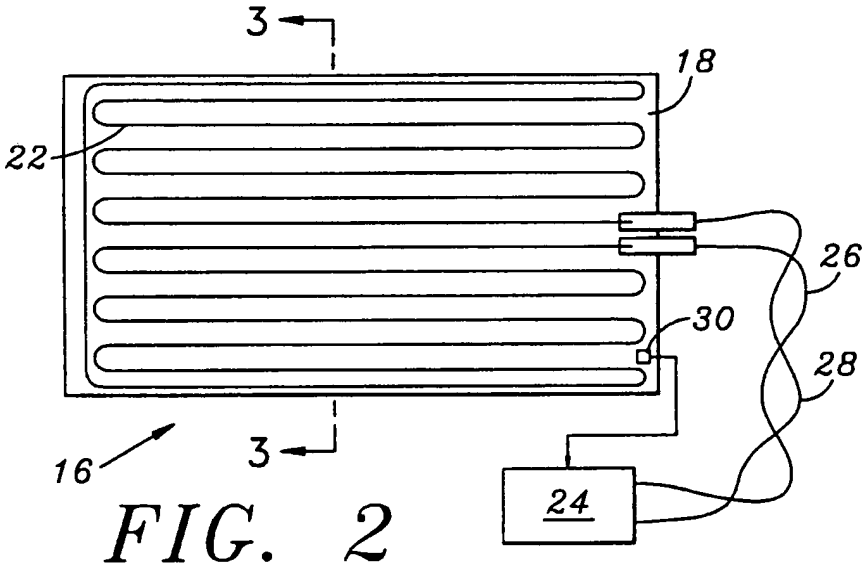


FIG. 2

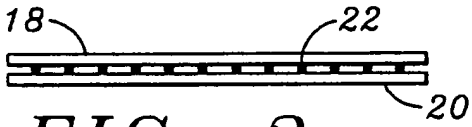
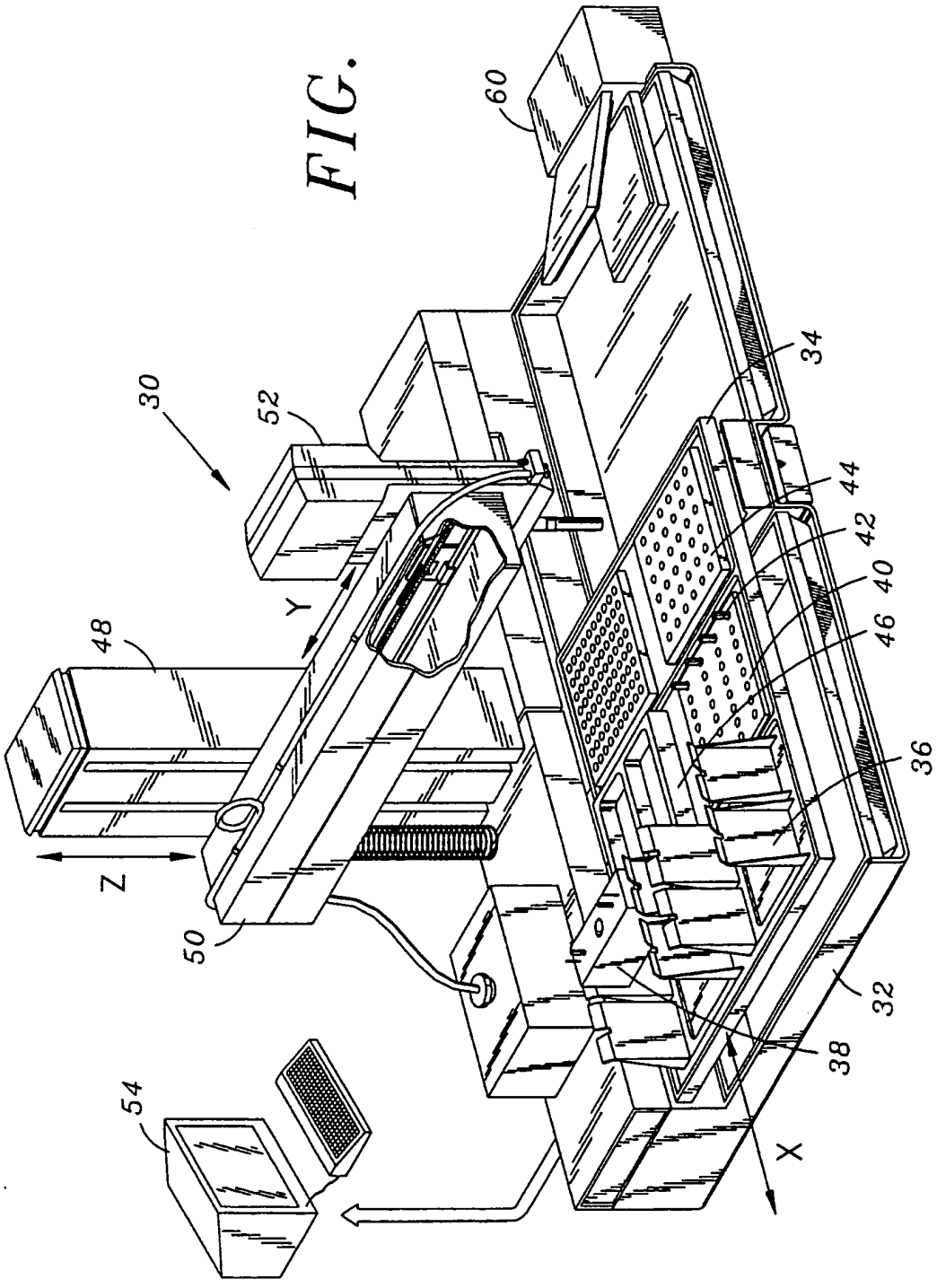


FIG. 3

FIG. 4



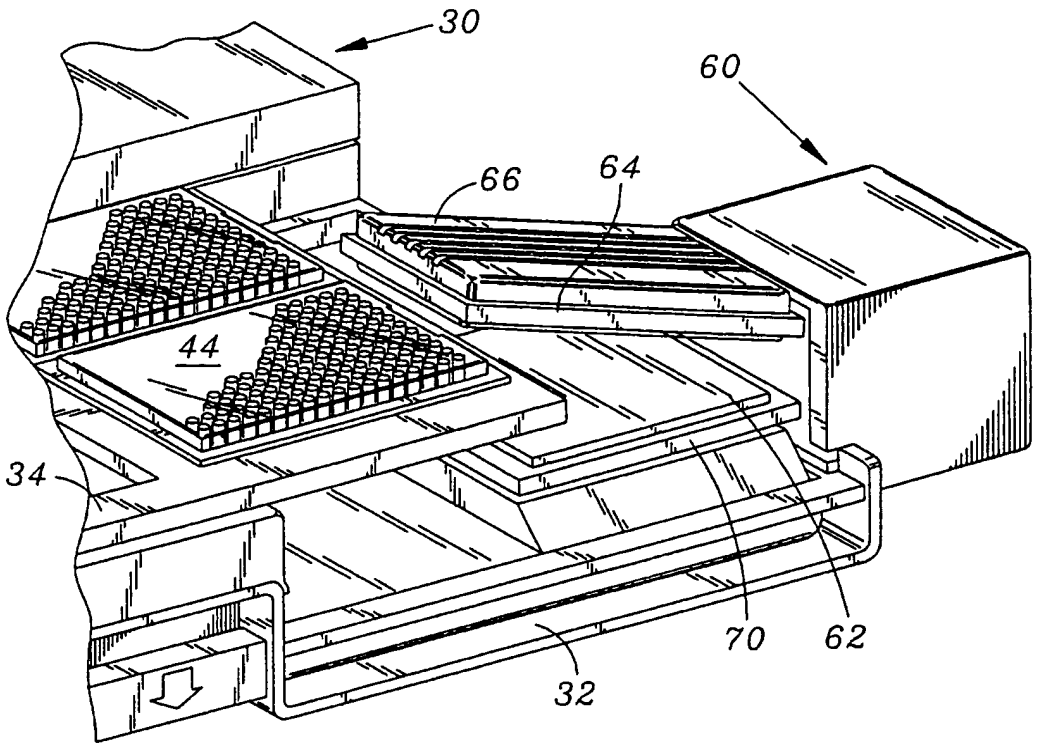


FIG. 5

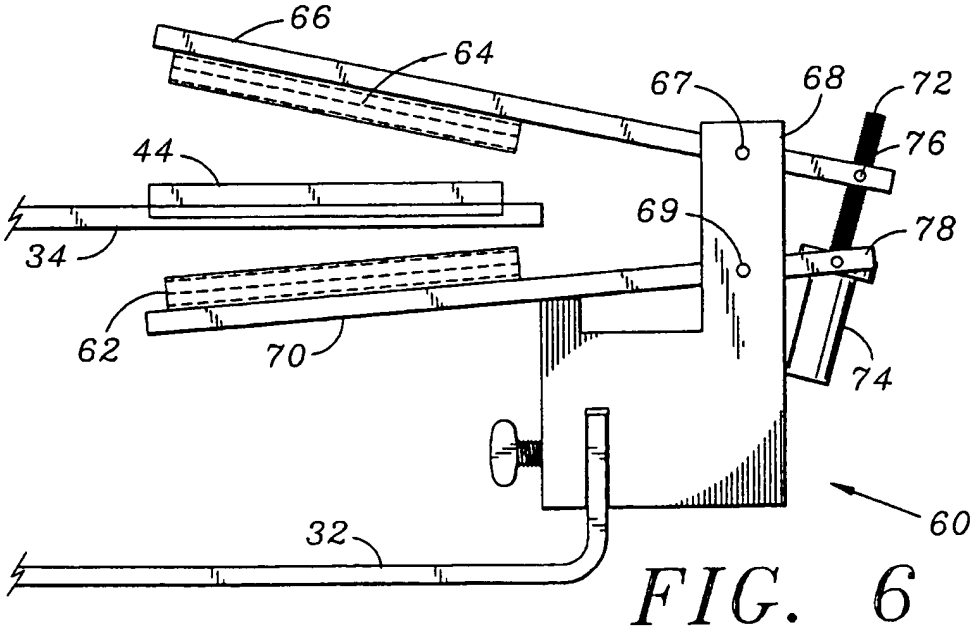


FIG. 6